FLORENCE COPPER

FLORENCE COPPER INC.
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florencecopper.com

October 9, 2018
File No. 132473-002

Mr. David Albright
U.S. Environmental Protection Agency
Region 9, Ground Water Office, WTR-9
75 Hawthorne Street
San Francisco, California 94105-3901

Re: Transmittal of Summary of Mechanical Integrity Demonstrations for Shallow Monitoring Wells, Production Test Facility
Florence Copper Project, Florence Arizona

Dear Mr. Albright:

Florence Copper Inc. herewith transmits the enclosed Technical Memorandum, *Summary of Mechanical Demonstrations for Shallow Monitoring Wells, Production Test Facility, Florence Copper Project* prepared by Haley & Aldrich, Inc.

Please contact me at 520-374-3984 if you require any additional information.

Sincerely,
Florence Copper Inc.

Daniel Johnson
Vice President – General Manager

cc: Nancy Rumrill, U.S. Environmental Protection Agency
Maribeth Greenslade, Arizona Department of Environmental Quality

Enclosure

Taseko

HALEY & ALDRICH, INC.
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TECHNICAL MEMORANDUM

9 October 2018
File No. 132473-002

TO: Florence Copper Inc.
Dan Johnson

C: Florence Copper Inc.
Ian Ream

FROM: Haley & Aldrich, Inc.
Lauren Candreva R.G.

SUBJECT: Summary of Mechanical Integrity Demonstrations for Shallow Monitoring Wells, Production Test Facility, Florence Copper Project, Florence, Arizona

Florence Copper Inc. (Florence Copper) has constructed a Production Test Facility (PTF) at the Florence Copper Project in Florence, Arizona to demonstrate the In-situ Copper Recovery (ISCR) method for the production of copper. The PTF consists of 24 mine block wells, 7 supplemental monitoring wells, and 2 operational monitoring wells within the Permit Area of Review (AOR) defined in the Underground Injection Control (UIC) permit R9UIC-AZ3-FY11-1 issued by the United States Environmental Protection Agency (EPA).

Pursuant to 40 Code of Federal Regulations §146.8, all Class III wells within the AOR of review must demonstrate mechanical integrity, Parts I and II, by the methods and schedules of Part II.E.3 of the UIC permit. Florence Copper notified the EPA of their intent to complete mechanical integrity demonstrations at the supplemental monitoring wells in a letter dated 31 March 2017. The EPA responded to Florence Copper in a letter dated 27 April 2017 that at the time the supplemental monitoring wells and observation wells were tested the Class III UIC permit including the PTF (R9UIC-AZ3-FY11-1) was stayed pending appeal and that the testing should be completed under the existing Class III UIC permit (Permit No. AZ396000001).

Part I Mechanical Integrity demonstration as required by Part II.E.3.a.i of the UIC permit includes:

1. Completion of a Standard Annular Pressure Test (SAPT).
2. Continuous pressure monitoring in active injection wells.

Part II mechanical integrity demonstration as required by Part II.E.3.a.ii includes:

1. A monitoring program to verify the absence of fluid movement through vertical channels adjacent to the well bore in observation and multi-level sampling wells.

2. A demonstration that injectate is confined to the proper zone by use of temperature and radioactive tracer logging to be completed after 6 months of injection.
3. Demonstration of the complete filling of the annulus by providing records of cementing volumes and cement evaluation logs.

All Class III wells constructed within the AOR of the PTF were evaluated by applicable Part I and Part II requirements. Since the injection at the PTF has not commenced the only applicable requirement for Part I is the SAPT and for Part II is the demonstration of the complete filling of the annulus with cement.

Summary of Part I Demonstration Results

All wells were evaluated for internal mechanical integrity by completing a SAPT. All wells completed into the bedrock oxide zone, which is the mining/injection zone, passed the SAPT. There were four shallow monitoring wells, completed in the Upper Basin-Fill Unit (UBFU) and Lower Basin-Fill Unit (LBFU) using mild steel casing that did not pass the SAPT. Those wells were supplemental monitoring wells M55-UBF, M56-LBF, M61-LBF, and operational monitoring well MW-01-LBF.

The reason for the unsuccessful demonstration of internal mechanical integrity of these wells was not immediately apparent. The design, materials, and methods used to construct these wells were similar to other wells that did successfully pass the SAPT. The steel casing connections are F-480 type square thread that require an O-ring to fully seal. One possible reason for the failure may be a bad joint connection in the threaded mild steel casing, although no obvious thread, O-ring, or completed connection defects were noted in pre-installation inspection in the field.

The wells were all constructed in accordance with Appendix B of the UIC Permit including grouting via the submerged tremie pipe method. The well materials were inspected by Haley & Aldrich, Inc. field personnel prior to installation including inspection of the thread and ensuring proper installation of the O-rings.

Summary of Part II Demonstration Results

Cement volume calculations and geophysical logs were compared to demonstrate Part II mechanical integrity. A summary of the results of each comparison is included below.

M55-UBF

Well M55-UBF annular grout volume was calculated to be 3.9 cubic yards, during well installation 5.1 cubic yards of Type V neat cement grout was installed in the borehole annulus. The installed volume exceeds the calculated volume indicting that grout has likely penetrated the formation, resulting in an effective seal.

The sonic cement bond log (CBL) tool is not effective in unsaturated formation. Due to the limited saturated interval in this shallow well completed in the UBFU, the CBL was only completed across the

short saturated interval from approximately 232 to 240 feet. The CBL for this well is somewhat inconclusive due to the very limited (8 foot) sampling interval. The density logs that were completed included compensated density and 4pi gamma-gamma density measured across the grouted interval. These logs showed consistent results down to 200 feet below ground surface (bgs). Between 200 to 216 the density decreased slightly but was consistent across that zone.

M56-LBF

Well M56-LBF annular grout volume was calculated to be 5.5 cubic yards, during well installation 7.0 cubic yards of Type V neat cement grout was installed in the borehole annulus. The installed volume exceeds the calculated volume indicating that grout has likely penetrated the formation, resulting in an effective seal.

Sonic CBL and other geophysical surveys conducted to evaluate cement bond at M56-LBF indicate that there is high bond and consistent density material behind the casing to 280 feet bgs, the bottom 17 feet of the cement seal from 280 to 297 feet bgs shows a lowered bond and decreased 4pi density. However, the quantitative compensated density value is approximately 1.3 grams per cubic centimeter which is similar to the value in the upper portion of the well. The shift in the 4pi density occurs at the contact with the middle fine-grained unit and may be affected by the change in lithology at this depth. These results indicate that cement is present through the full length of the seal interval.

M61-LBF

Well M61-LBF annular grout volume was calculated to be 7.5 cubic yards, during well installation 7.5 cubic yards of Type V neat cement grout was installed in the borehole annulus. The installed volume exceeds the calculated volume indicating that grout has likely penetrated the formation, resulting in an effective seal.

Sonic CBL and other geophysical surveys conducted to evaluate cement bond at M61-LBF indicate that there is high bond and consistent cement material behind the casing to 400 feet bgs. The bottom 10 feet of the cement seal shows a lower degree of bonding, but the density of the material is consistent with the material above through 410 feet. Cement may have mixed with drill mud or formation in the lowest 10-feet of the seal interval. These results indicate that cement is present through the full length of the seal interval.

MW-01-LBF

Well MW-01-LBF calculated annular grout volume was calculated to be 8.8 cubic yards, during well installation a cement truck arrived onsite with 8 cubic yards of Type V neat cement grout. Before installation the grout was weighed to confirm the design mix and the grout weighed 15.8 pounds per gallon (lbs/gal), more than neat Type V cement should weigh. The cement was inspected to ensure no additives were present and that the ticket indicated the correct mix, and then additional water was added by the truck driver and mixed thoroughly to decrease the weight. After the addition of water, the grout weight was decreased to 14.9 lb/gal. The volume of this additional water was not included in the

total recorded for installation and because the water was added by the cement truck driver and pumped directly into the mixer, so the volume could not be quantified or estimated at the time.

For the purpose of this evaluation the volume that would be required to decrease the fluid weight by the measured values was calculated and the approximate volume of water required to decrease the fluid weight from 15.8 lbs/gal to 14.9 lbs/gal would be 220 gallons or approximately 1.1 yard. This additional volume brings the total volume of grout weighing 14.9 lbs/gal installed to 9.1 cubic yards and exceeds the calculated volume, resulting in an effective seal.

Sonic CBL and other geophysical surveys conducted to evaluate cement bond at MW-01-LBF indicate that there is high bond and consistent cement material behind the casing to 218 feet bgs, from approximately 218 to 220 feet there is a small zone of lower density but the bond is good through this interval. The bond is good down to approximately 280 feet, from 280 to the bottom of the grout zone at 310 the bond is lowered but the density does not change through this interval indicating that the material behind the casing is consistent. These results indicate that cement is present through the full length of the seal interval.

Conclusions

The wells for which a successful internal mechanical integrity demonstration could be made by the SAPT method have two attributes in common; they are all monitoring wells located outside of the PTF mine block, and are all terminated lithologically above the planned injection and recovery zone. As designed and constructed, these wells were never planned for use in injecting and recovering ISCR solutions. For this reason, they were constructed of material (mild steel) that is not compatible acidified solution. They will never have any acidified solution injected or extracted from them.

Data collected to demonstrate Part II mechanical integrity demonstrate that all of the wells described above have cement volumes meeting or exceeding calculated volumes, and evaluation of the material in the borehole annulus show that cement is present throughout the entire seal interval for each of these wells.